

5.1 Replication and division of nuclei and cells

Name: _____ Class: _____ Date: _____

Total: 12 marks

Objective

Build the skills to answer exam questions on **replication and division of nuclei and cells** —the structure of a **chromosome** 染色体, the **mitotic cell cycle** 有丝分裂细胞周期, **telomeres** 端粒, **stem cells** 干细胞 and **tumours** 肿瘤.

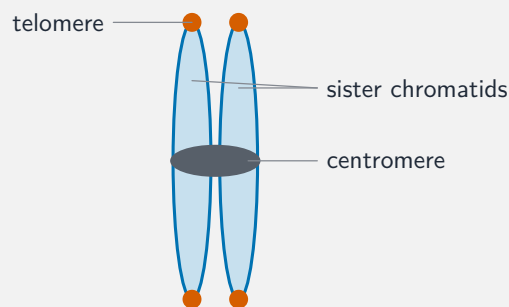
You must be able to:

- describe the structure of a chromosome (DNA, histones, sister chromatids, centromere, telomeres)
- explain the importance of mitosis and outline the cell cycle (interphase, mitosis, cytokinesis)
- outline the roles of telomeres and stem cells, and how a tumour forms

1 Worked examples

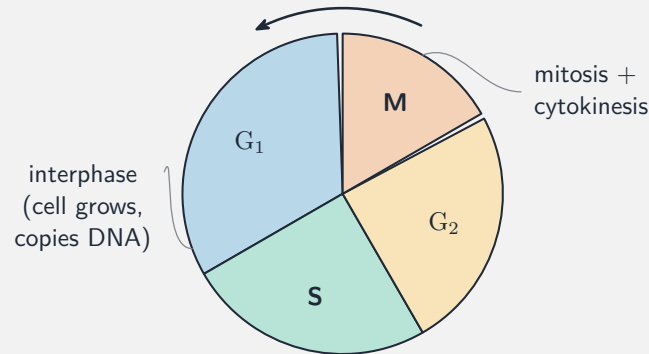
■ The structure of a chromosome

A chromosome is one long DNA molecule wound around **histone** 组蛋白 proteins. After **replication** 复制 it is two identical **sister chromatids** 姐妹染色单体 joined at the **centromere** 着丝粒, with **telomeres** capping the tips.



After replication: two sister chromatids joined at the centromere, telomeres at the tips

■ The mitotic cell cycle



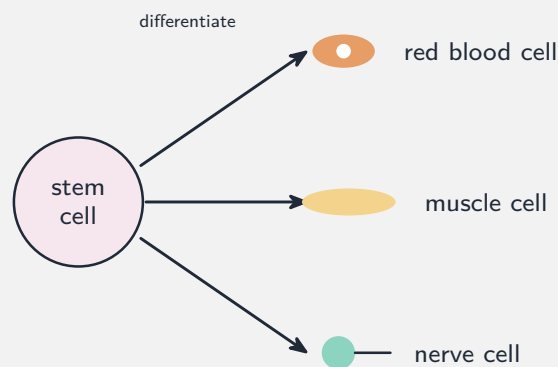
Most of the cycle is interphase (G, S, G); mitosis and cytokinesis are short

- **interphase** 间期—growth (G), DNA replication (S), growth/preparation (G).
- **mitosis** 有丝分裂—the nucleus divides into two **genetically identical** nuclei.
- **cytokinesis** 胞质分裂—the cell splits into two daughter cells.

Mitosis matters for growth, replacement of dead cells, tissue repair and **asexual reproduction** 无性生殖.

■ Telomeres, stem cells and tumours

Telomeres carry **no genes**, so the small amount lost at each replication does not lose genes. A **stem cell** is unspecialised, keeps dividing, and can **differentiate** 分化 into specialised cells. If the control of the cycle is lost, a cell divides uncontrollably to form a **tumour**.



One stem cell can differentiate into many specialised cell types

2 Practice

2.1 Name the parts of a chromosome labelled by these descriptions: (a) where two sister chromatids are joined; (b) the protective caps at the tips. [2]

2.2 State what happens in the **S phase** of interphase. [1]

3 Exam-style questions

3.1 During which phase of the cell cycle is DNA replicated? [1]

- **A** G
 - **B** S
 - **C** G
 - **D** mitosis
-

3.2 Why does the loss of a small length of telomere during replication **not** harm the cell? [1]

- **A** telomeres are made of protein
 - **B** telomeres carry no genes
 - **C** telomeres are replaced by histones
 - **D** the lost DNA is copied later
-

3.3 Explain why mitosis produces two genetically identical daughter cells, and give **two** situations where this is important. [3]

3.4 (a) State what is meant by a stem cell. [2]

(b) Explain how the loss of control of the cell cycle can lead to a tumour. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **5.1 Replication and division of nuclei and cells** past-paper sheet in the Library, or try these in **Practice mode**:

- 9700/11 N25 —Q20 (cell cycle)
- 9700/13 N25 —Q21 (mitosis and chromosomes)
- 9700/14 N25 —Q20 (stem cells / telomeres)

Solutions

2.1 (a) centromere; (b) telomeres.

2.2 the DNA is replicated / copied.

3.1 B. DNA is replicated in the S phase.

3.2 B. Telomeres carry no genes, so losing a little does not lose genes.

3.3 mitosis copies the DNA exactly (S phase) and separates identical sister chromatids, so each daughter gets an identical set of genes; any two of: growth / replacement of dead cells / tissue repair / asexual reproduction.

3.4 (a) an unspecialised cell that can keep dividing and can differentiate into specialised cells.

(b) the cell divides repeatedly without stopping, forming an uncontrolled mass of cells —a tumour.